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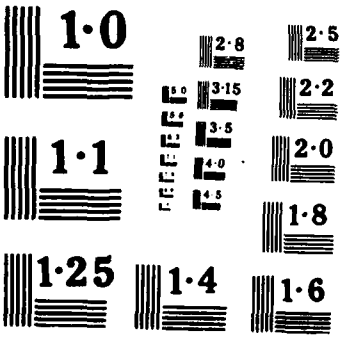
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Dental emergencies in a military population can have a detrimental influence on military operations and readiness, and can lead to costly medical evacuation procedures (1-4). Since caries-related dental emergencies constitute an appreciable share of all military dental emergencies (2,5), maintenance of a low caries prevalence in military personnel is important.

Treatment of caries in a military environment is governed by many factors including: individual need and demand, and patient and dental service availability. The purpose of this study was to examine one outcome of this treatment process, i.e. the length of time needed to treat defective surfaces identified at the initial examination, in a sample of U.S. naval personnel. This information is useful in planning future directions in dental care delivery.

Method

The sample was composed of active duty naval personnel stationed at the Naval Training Center, Great Lakes. A list of personnel ordered by social security number was used for selecting the sample. The records of the first five persons on each page of the list who met the following criteria were selected: 1) a dental record was available, 2) the individual was not assigned to a dental activity, and 3) the individual had his/her initial dental examination performed between January 1, 1979 and December 31, 1983. This latter criterion permitted a follow-up period ranging from 18 to 78 months.

Records were surveyed, and teeth and surfaces scheduled for restoration were noted. Although a small percentage of these were probably so indicated because of lost or defective restorations, both possibilities were grouped under the terms "caries" or "lesion" for the following reasons: 1) the distinction between caries and defective restorations could not be made from the records, 2) presentation of data was simplified, and 3) most teeth needing restoration were assumed to be carious. Regardless, dental emergencies can result from either caries or defective restorations.

Data were recorded pertaining to caries present at the time of initial naval dental examination and subsequent treatment of those lesions. The nature and disposition of carious lesions which developed after the initial examination were not considered because follow-up observation would have been limited. Data collected from each record included: 1) number and location of diseased teeth and surfaces, 2) estimate of the depth of each carious lesion from available radiographs (usually bitewings and panoramic view) as outlined in Table 1, 3) number of surfaces involved in each lesion, 4) date the lesion was treated, or the date on which the data were collected if treatment was not performed (censored data), and 5) date on which all treatment for caries in an individual was completed, or date of data collection (censoring date), if some lesions remained untreated.

Results

The systematic sampling procedure yielded a sample size of 506 subject dental records, 385 of which (76.1 percent) indicated a need for restorative (operative) treatment. Persons requiring treatment had an average of 4.92 diseased teeth (SD = 3.83) and 8.42 diseased surfaces (SD = 7.30). The distributions of these variables are typical and are shown in Figures 1 and 2.

Of primary concern was the time elapsed to caries treatment. This can be conceptualized in terms of survival analysis (life tables) where "survival" is measured by the duration of the carious state and "death" is associated with treatment. Appropriate statistical techniques allow the estimation of survival functions despite differences in subjects' time under study and subjects' leaving the study prior to treatment (censored data) (6). The data were analyzed from the perspectives of the survival of all lesions in a mouth (mouth unit), and the survival of individual lesions. Censoring information and survival quantiles for mouths and different lesion types are shown in Table 2.

Cumulative survival of persons with one or more untreated lesions is presented in Figure 3. One-fourth of all persons with one or more lesions were treated to zero lesions in 4.03 months; 50 percent were treated by 33.38 months.

There were 1894 total lesions, and a survival curve of these is presented in Figure 4. Since the criterion of total mouth restoration is not imposed, substantially greater amounts of treatment are evident. After an estimated 1.05, 6.49, and 43.18 months, 25, 50, and 75 percent of the lesions were treated, respectively.

Survival curves for lesions of different depths are presented in Figure 5. This figure graphically demonstrates significant differences in cumulative survival functions associated with lesion depth ($p<.001$, note however, that since observations are not independent, this finding is only suggestive). In addition to being treated earlier, a relatively greater proportion of deep lesions are treated during the course of the study.

Of 3,242 original carious surfaces, 726 (22.4 percent) remained untreated. As shown in Figure 6, a small percentage of the sample contributed a large percentage of these. Ten percent of the sample having lesions (7.6 percent of all subjects) had 58.9 percent of the untreated surfaces. Twenty percent (15.2 percent of all subjects) had 78.9 percent of the untreated surfaces.

The phenomenon of a small percentage of subjects being responsible for most unmet treatment needs is also shown in Figure 7. The majority of persons are on the diagonal which represents complete treatment. Moving to the right and down,

proportionately fewer subjects have more untreated surfaces. The three subjects in the extreme lower right appear to represent a distinct subgroup that has not received treatment comparable to most other subjects.

Discussion

A limitation of this study was the inability to distinguish carious lesions from teeth with lost or defective restorations. The number of carious lesions identified in this study, therefore, was a slight overestimation of the number actually present, and data are more accurately associated with a need-for-restoration than caries. From a practical view, however, the management of either condition is essentially the same.

Inspection of the raw data suggests that there may be an overestimation of lesions requiring treatment because of diagnostic reversals. Small "lesions", which subsequent dental officers might decide to observe rather than restore, would prevent a mouth from being considered completely restored. The possibility of diagnostic reversals is also most likely for "A" lesions, but may extend to some "B" lesions as well. Neither lesion type is considered to be a primary decremental factor in operational efficiency.

The survival curves for the different lesion types presented in Figure 5 are most likely due to a clinical practice of restoring the most severe lesions first. Fifty percent of all lesions are treated in slightly more than 6 months, and this is consistent with earlier findings that 50 percent of amalgam restorations planned at enlistment are accomplished during the first six months (7). However, the survival curves for all lesions level off at about 20 months after initial examination (Fig. 4) with approximately 20 to 30 percent of lesions surviving. Even though a large amount of work is performed early, and on the most severe lesions, lesions persist with the potential for creating dental emergencies. Fifty percent of all "U" lesions were restored within 1 1/3 months and 75 percent were restored within 6 1/3 months, however 6.8 percent (n=3) persisted at least 18 months.

Of interest is the fact that nearly 80 percent of the untreated surfaces were found in only 15 percent of the total sample. The reasons for this are only speculative, but may be associated with a lack of dental services available at certain duty stations (i.e. isolated duty), with work restrictions limiting time available for dental appointments, or with an individual aversion to dental care. This information is consistent with the clinical suspicion that a small number of personnel are responsible for most caries-related dental emergencies. It has been previously shown that 40 percent of continuing caries activity is concentrated in 5 percent of the Navy population (8).

The results of this study suggest that efforts to minimize the impact of caries-related dental emergencies on military operations should be directed toward treating that small segment of the population that harbors a disproportionately large number of teeth requiring restoration. Definition of this population at each activity would be desirable. Once identified, special recall, education, anxiety reduction, and treatment programs could be targeted for this group, if not already in place. Efforts should emphasize both the beneficial aspects of a healthy dentition as well as the adverse sequelae of dental disease.

This study was retrospective in nature and may not, necessarily, describe the contemporary or future status of caries treatment. These findings, however, provide a comparative framework and methodology to evaluate the impact of changes in naval dental treatment procedures.

Acknowledgments

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TABLE 1

SCALE FOR ESTIMATING CARIES DEPTH

A - Caries not involving dentin

B - Caries less than one-fourth through dentin

C - Caries one-fourth to three-fourths through dentin

U - URGENT. Caries more than three-fourths through dentin.

TABLE 2

SUMMARY OF CASES AND SURVIVAL DISTRIBUTION QUANTILES FOR INCOMPLETELY TREATED MOUTHS AND UNTREATED CARIOUS LESIONS AND LESION TYPES

VARIABLE	TOTAL	CASES TREATED	CENSORED	QUANTILE* (months) 75th	50th	25th
Mouth Unit	385	212	173	4.03	33.38	-
Lesion Type**	1894	1433	461	1.05	6.49	43.18
A	955	695	260	1.05	8.03	58.49
B	675	526	149	1.31	6.66	39.48
C	220	171	49	0.95	4.03	23.44
U	44	41	3	0.82	1.28	6.33

* product-limit estimates

** survival distributions for the four lesion types differ at $P<.001$ (Mantel-Cox and Breslow tests)

Figure 3. Life table of cumulative survival of subjects (mouth units) with one or more untreated carious lesions.

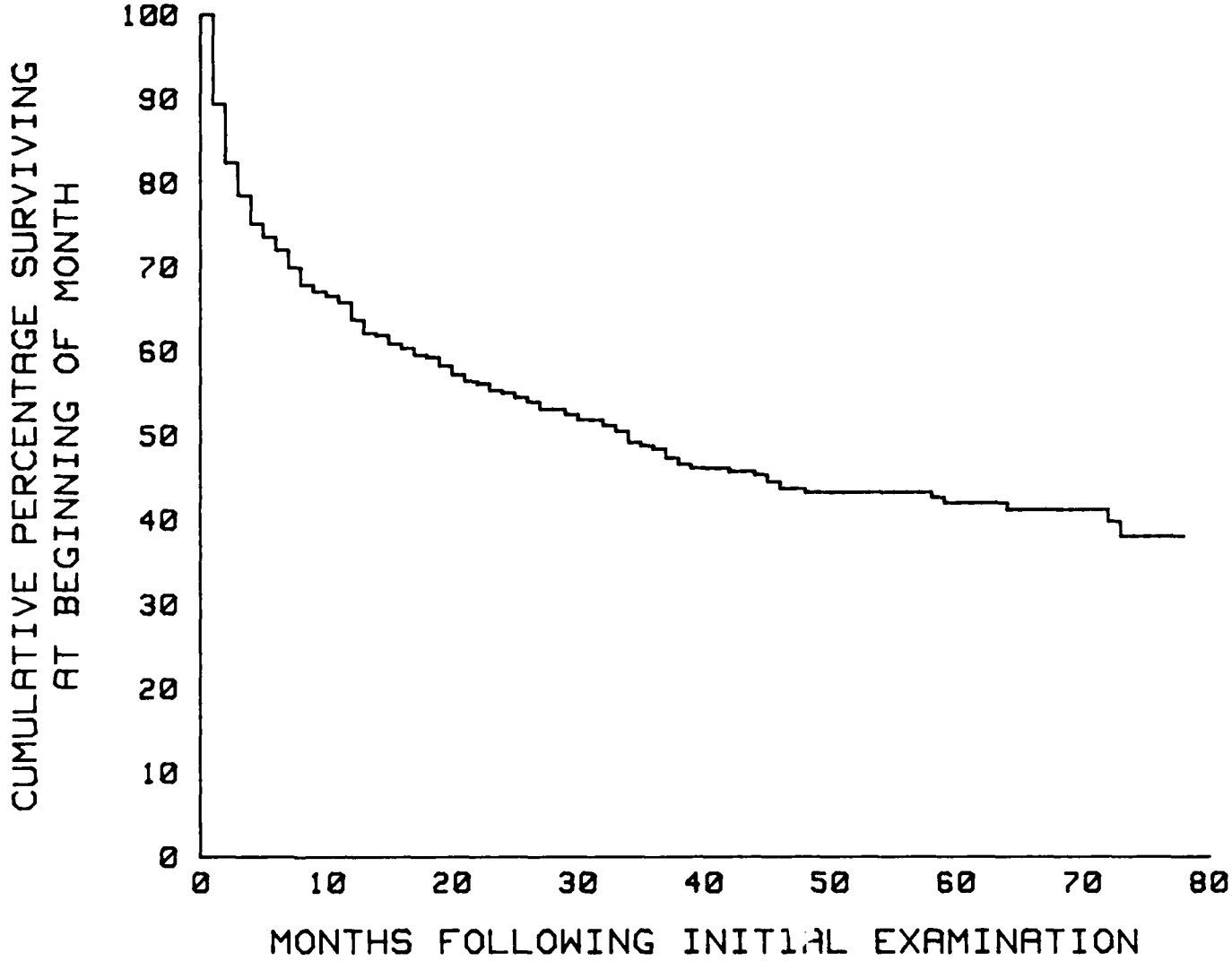


Figure 4. Life table of cumulative survival of 1894 individual carious lesions.

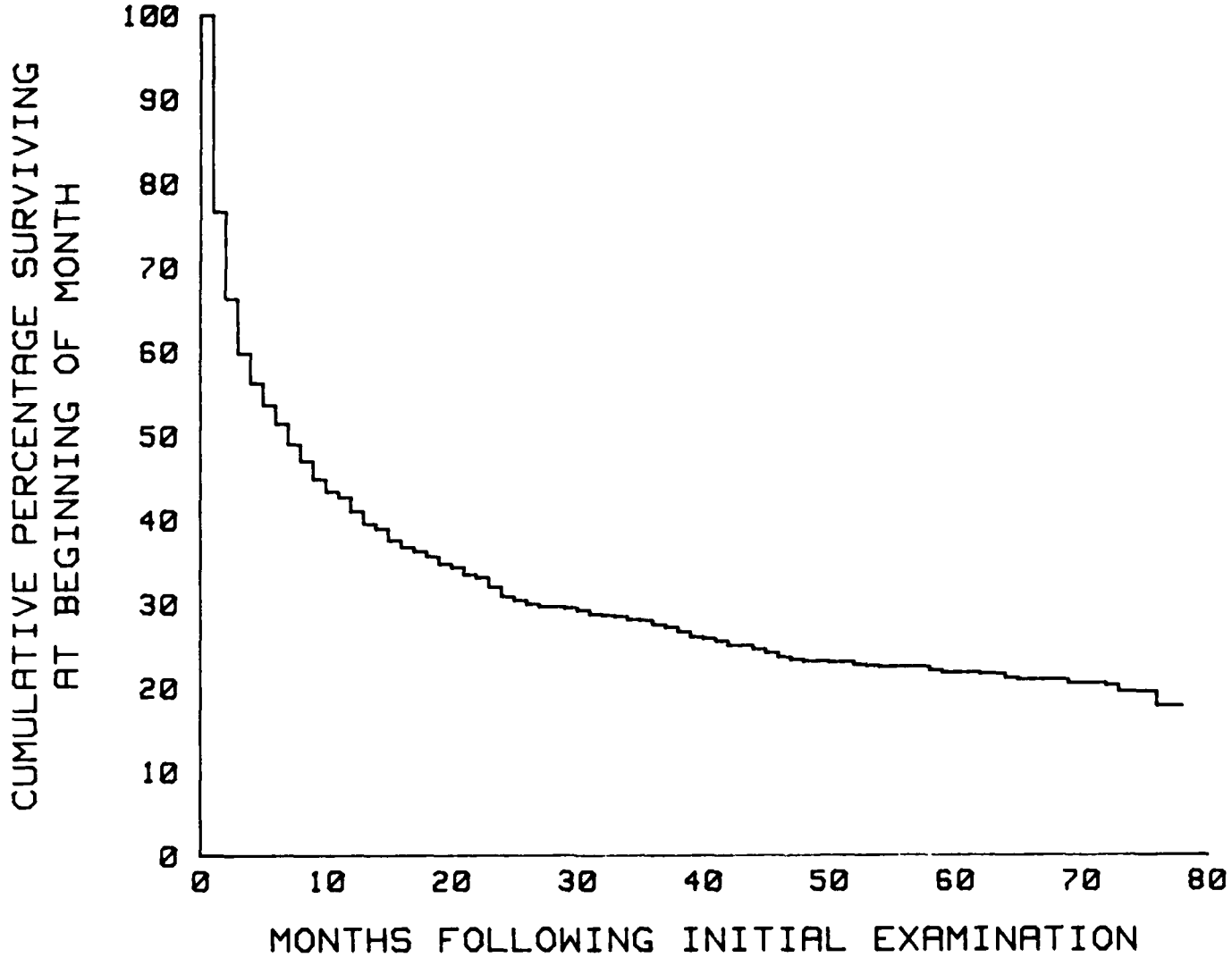


Figure 5. Life table of cumulative survival of 1984 individual lesions in four depth categories (see Table 1).

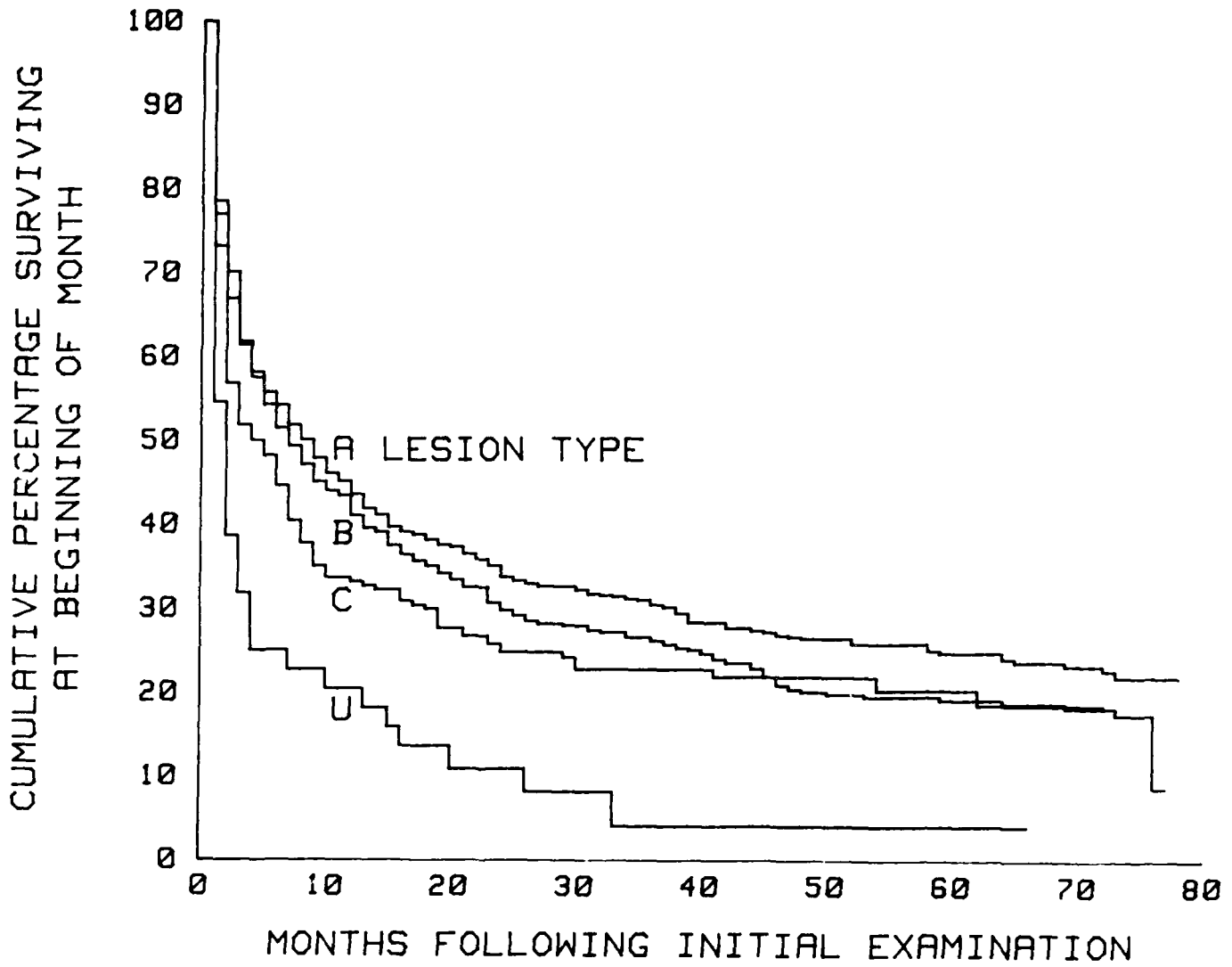


Figure 6. Cumulative percentage of untreated surfaces as a function of the percentage of subjects requiring treatment. Subjects were ordered by number of carious surfaces not treated and this was responsible, in part, for the regularity of the curve.

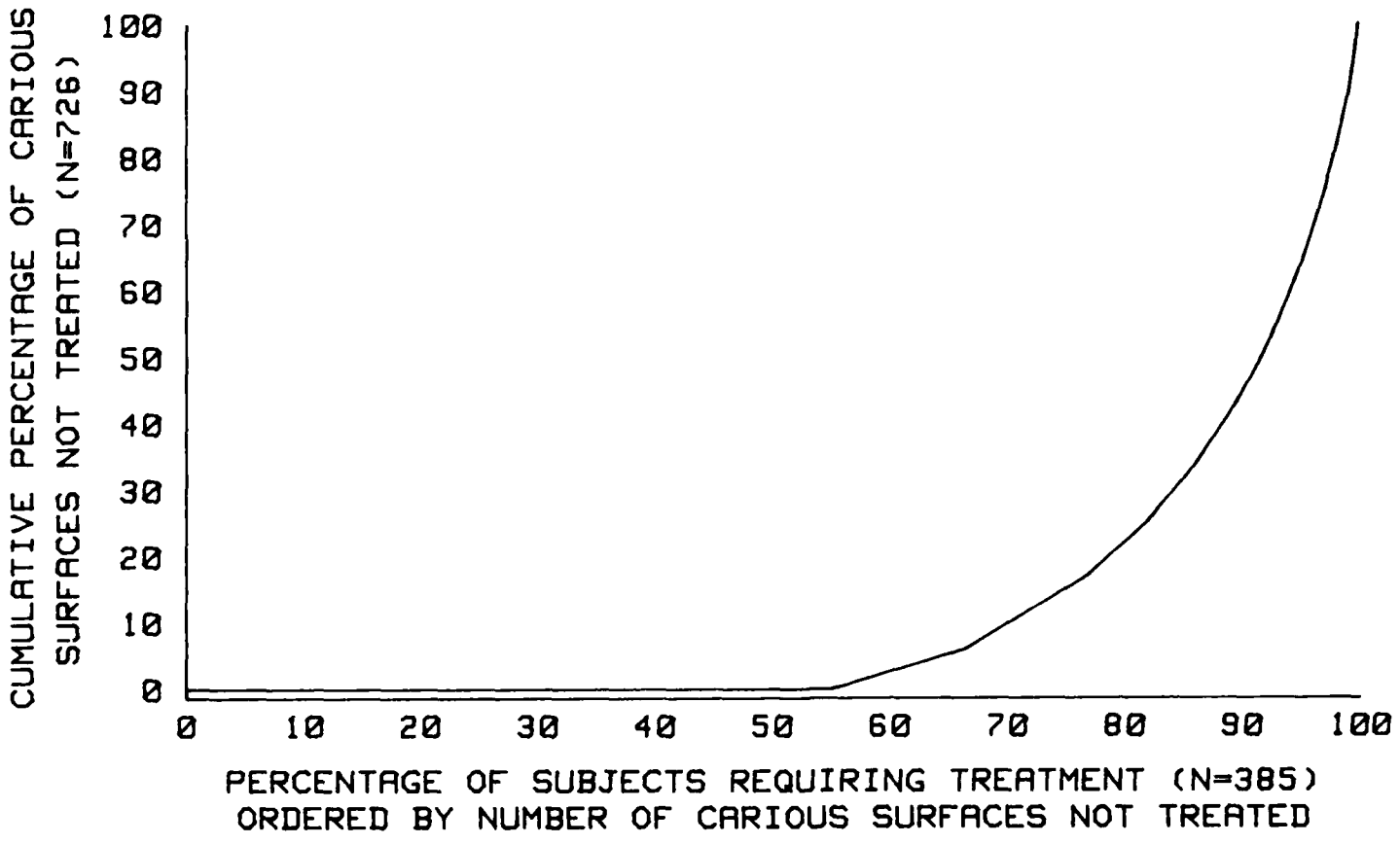
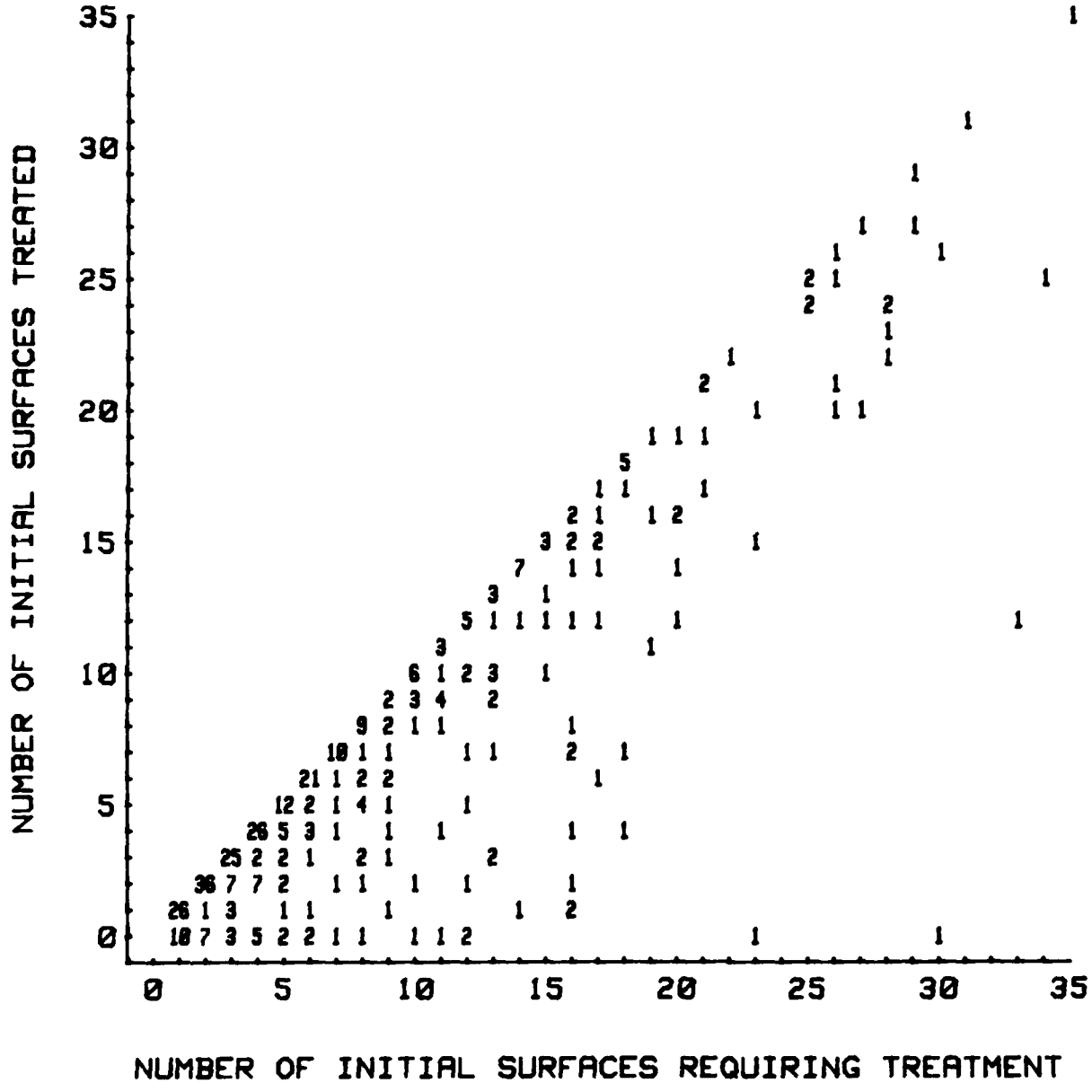


Figure 7. Scatter plot of number of initial surfaces requiring treatment versus number of initial surfaces treated for 385 subjects having at least 1 carious surface.



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19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Methods of survival analysis were used to evaluate the time required to treat caries (or defective dental restorations) identified at the initial examinations of 506 naval recruits. Nearly 80 percent of carious surfaces were treated during the 18 to 78 month observation period with half the treatment needs being met in the first 6.5 months of service. Deeper lesions were treated earlier and in proportionately greater numbers. Almost

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80 percent of those surfaces which remained untreated were found in only 15 percent of the total population.

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